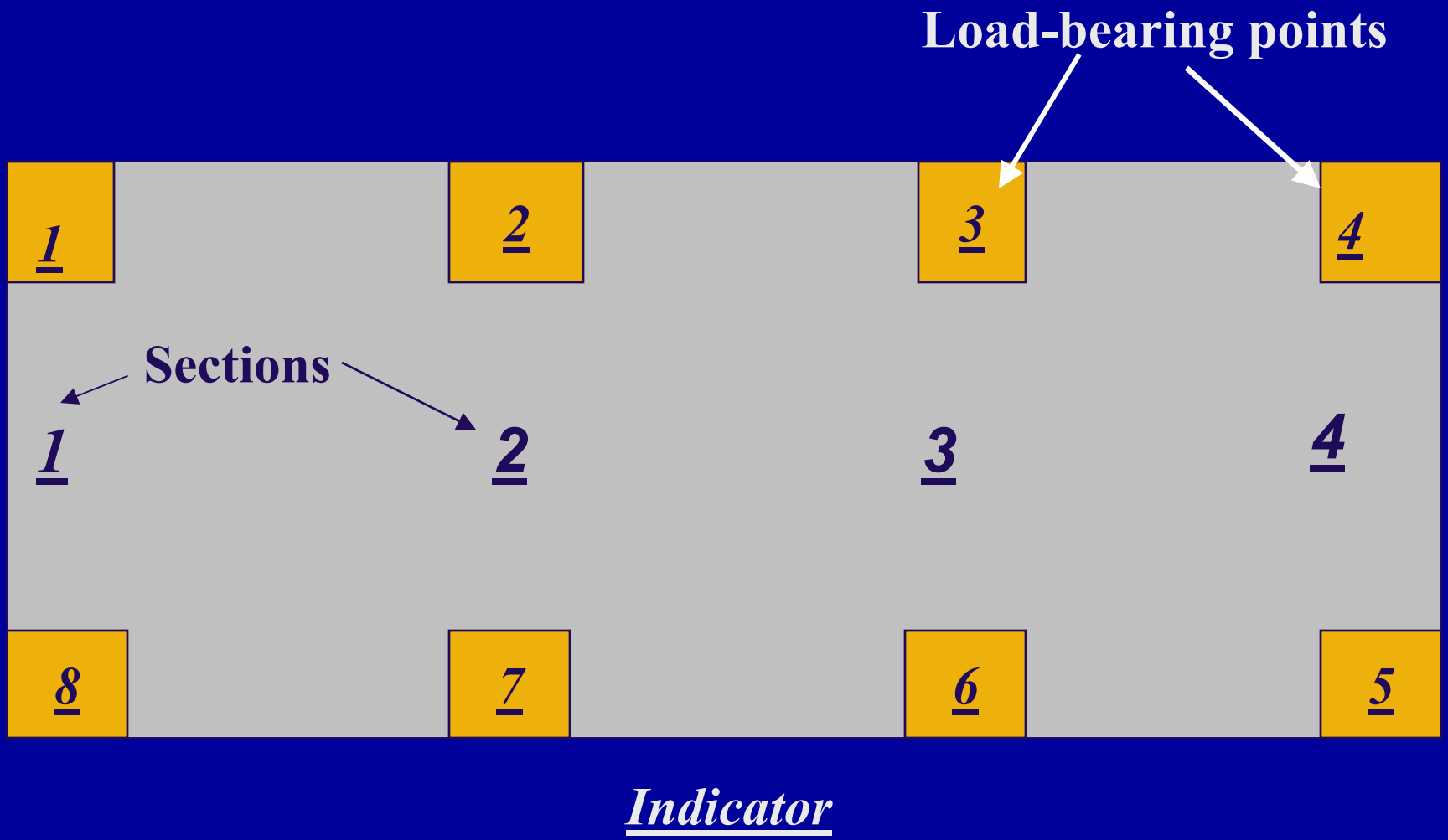
Chapter 6: Test

Planning the Test

- What are the scale's:
  - nominal and used capacity?
  - CLC or section rating?
- What is the value of d?
- How much known weight do you have and how is it broken down?
- Define the test pattern and placement of standards during testing.
- What other tests will be needed?

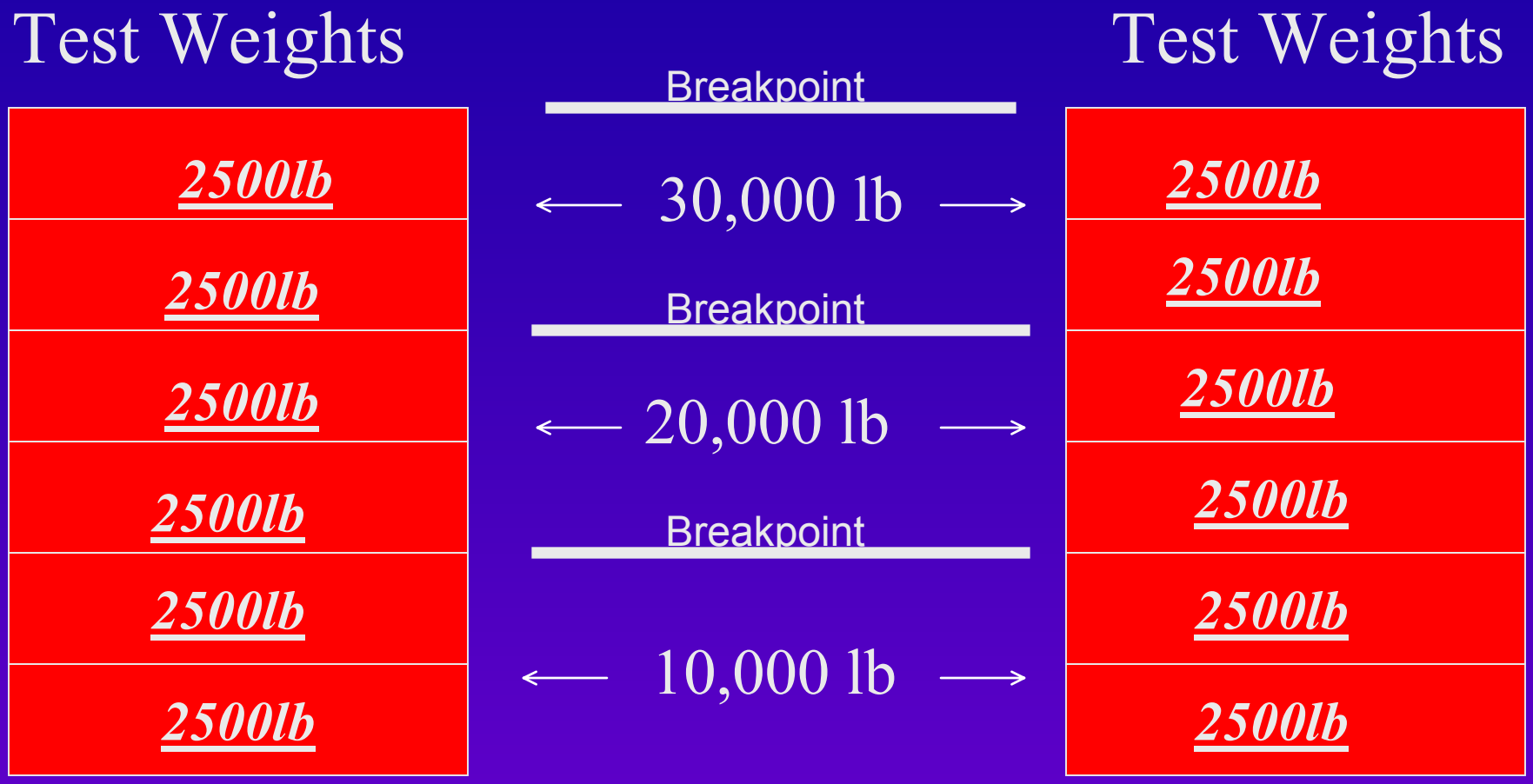
Identify Sections and Load-bearing Points



Preparation

- Position test equipment in a safe location.
- Apply needed error weights – weighbeams, digital scales (e.g., acceptance tolerance).

Take readings at tolerance break points: 100,000 x 20lb every 500 d = 10,000 lb

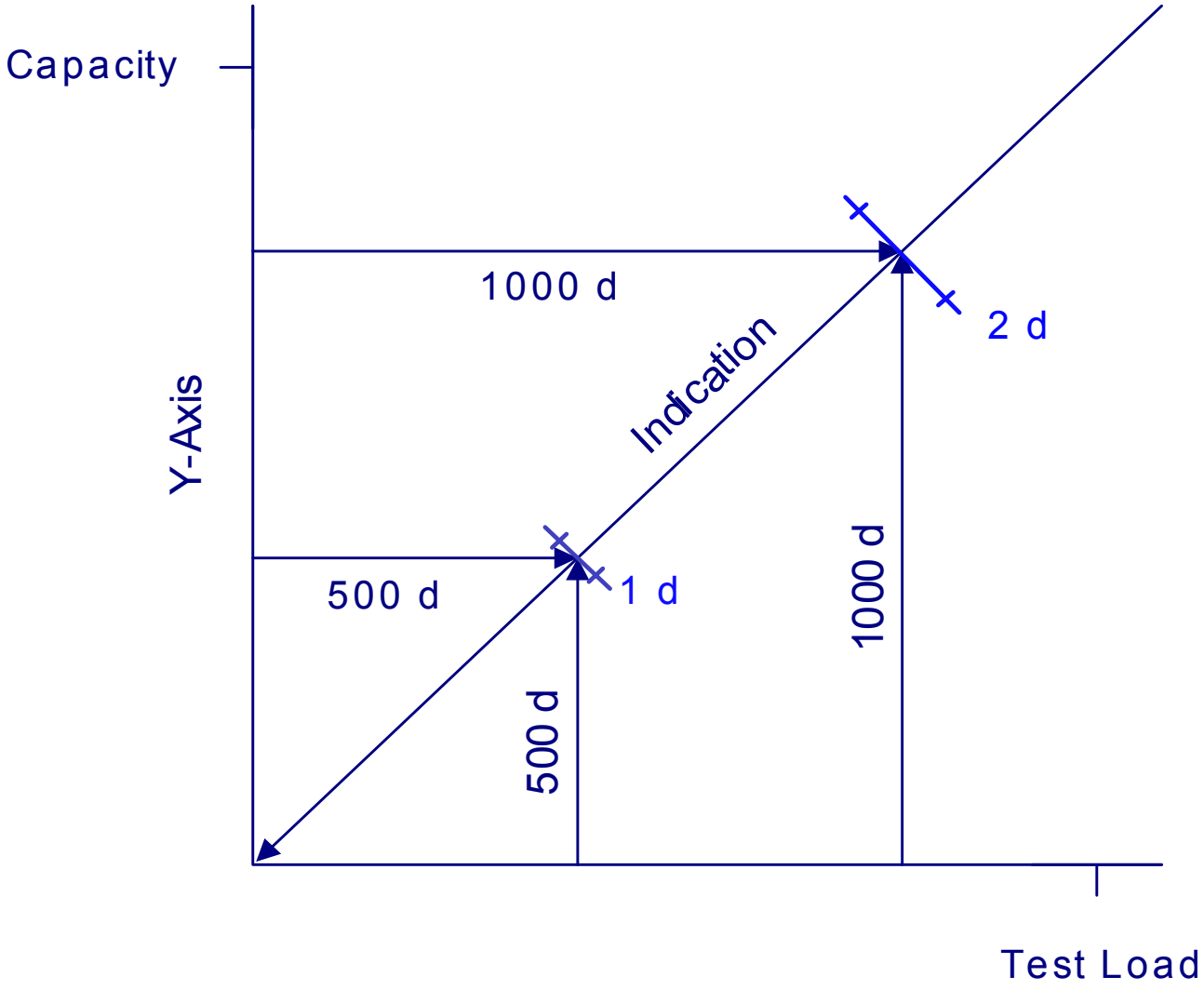


Indicators

- The type of indicator used will determine several of the tests to be conducted:
  - Beams (notches, multiple poises)
  - Dials (quarters are adjustable, tare bars)
  - Digital (electronic tests)
- Check T.N.5. Repeatability
- T.N.4.4. Agreement of Indications on Shift Tests

Indicators

- Beams: notches, poises, sensitivity test
- Dials: quarters, drop weights, decreasing load test.
- Digital Indicator: decreasing load test, width of zero, discrimination, RFI/EMI, zero operations (AZT), motion detection.



Increasing and Decreasing Tests - Linearity

EPO Tests

- Zero
- Increasing Load Test
- Shift Test
- Decreasing Load Test (automatic scales only)
- Return to Zero
- Strain or Substitution
- Return to Zero

N.1.1. Increasing-Load Test

- The basic performance test for a scale in which observations are made as known test weights are successively added to the load-receiving element of the scale.

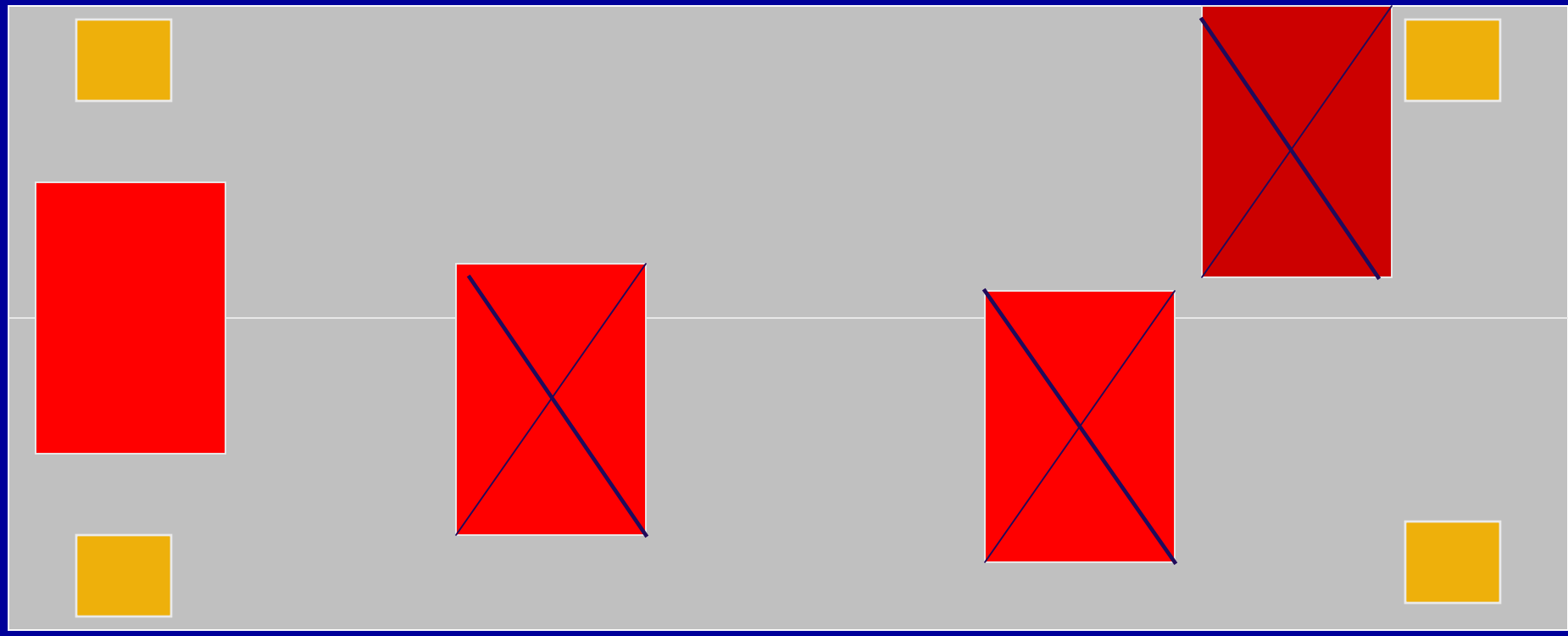
N.1.9. Zero Test

Increasing Load Test is conducted on Either Section of the Scale

Example: Two Section Scale

Correct and Incorrect Loading Positions

Do not load one side of the pattern to more than one-half the CLC or test load before loading the other side.



N.1.1. Increasing-Load Test

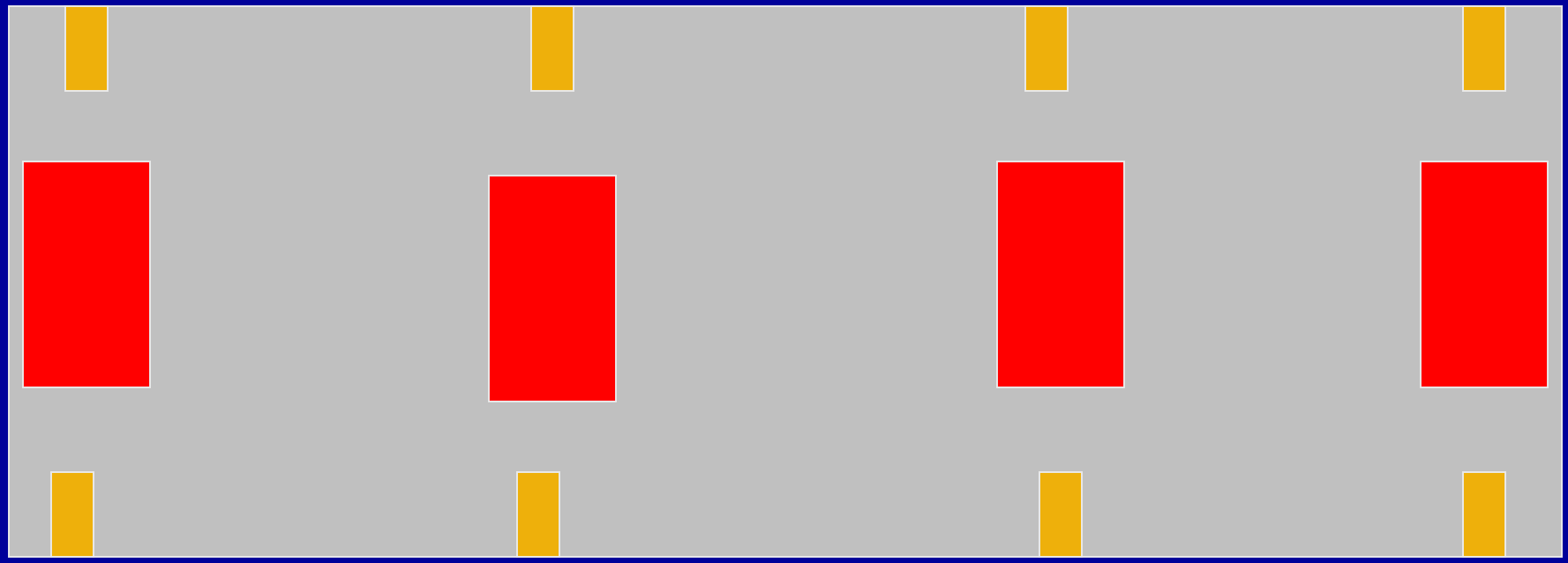

NEW MEXICO
PARTMENT OF AGRICULTU
SCALE TEST UNIT

N.1.3.4. Shift Test Procedures

- At least one shift test must be conducted with a test load equal to at least 12.5% of scale capacity. Apply the test ***load*** anywhere on the load receiving element using prescribed test pattern and within maximum loads.

- Position the weights in the center of each section, equidistant between the main load supports.

Shift Test Loading Patterns at Lowest and Maximum and Test Loads



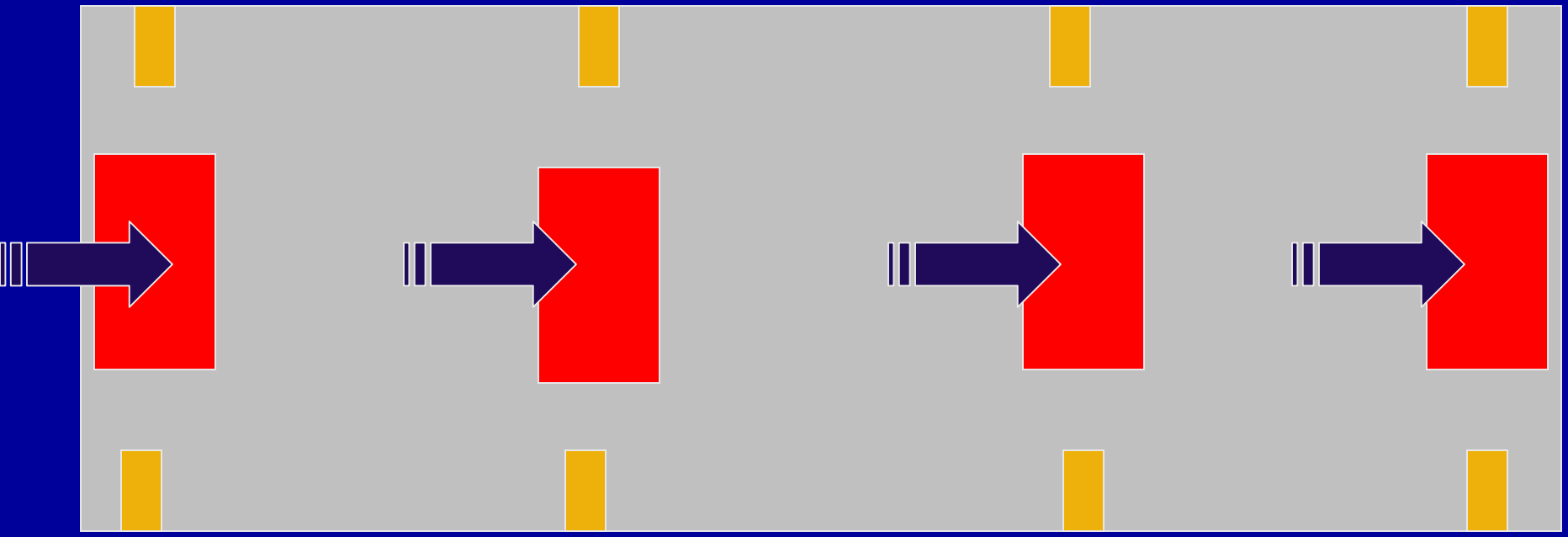
Shift Test Procedures

- A shift test using at two different test weight loads is recommended.
- The first test load should be equal to one-half of the available test weights and the second should include all of the test weights.

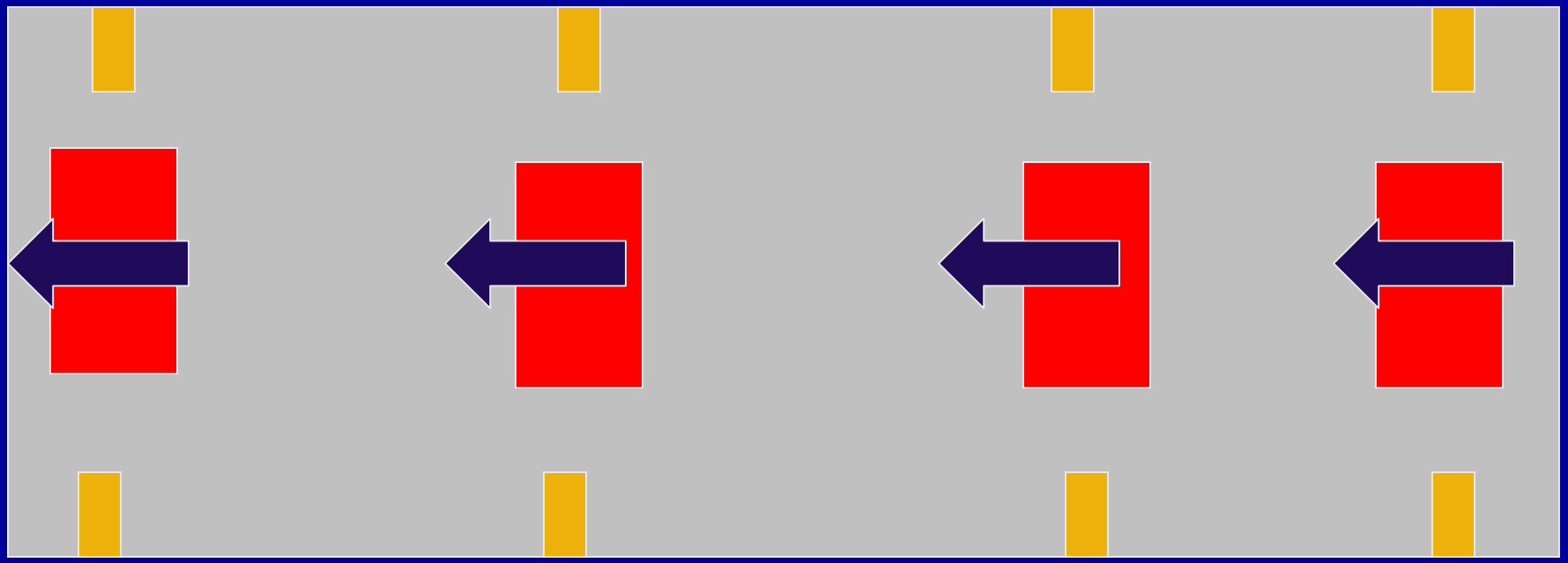
Shift Test Notes

- Vehicle scales may have different shift test results when the tests are initiated from different directions.
- A directional test should be conducted on all vehicle and axle-load scales using the heaviest test load.

Directional Test Loading Patterns - (4) Section Scale



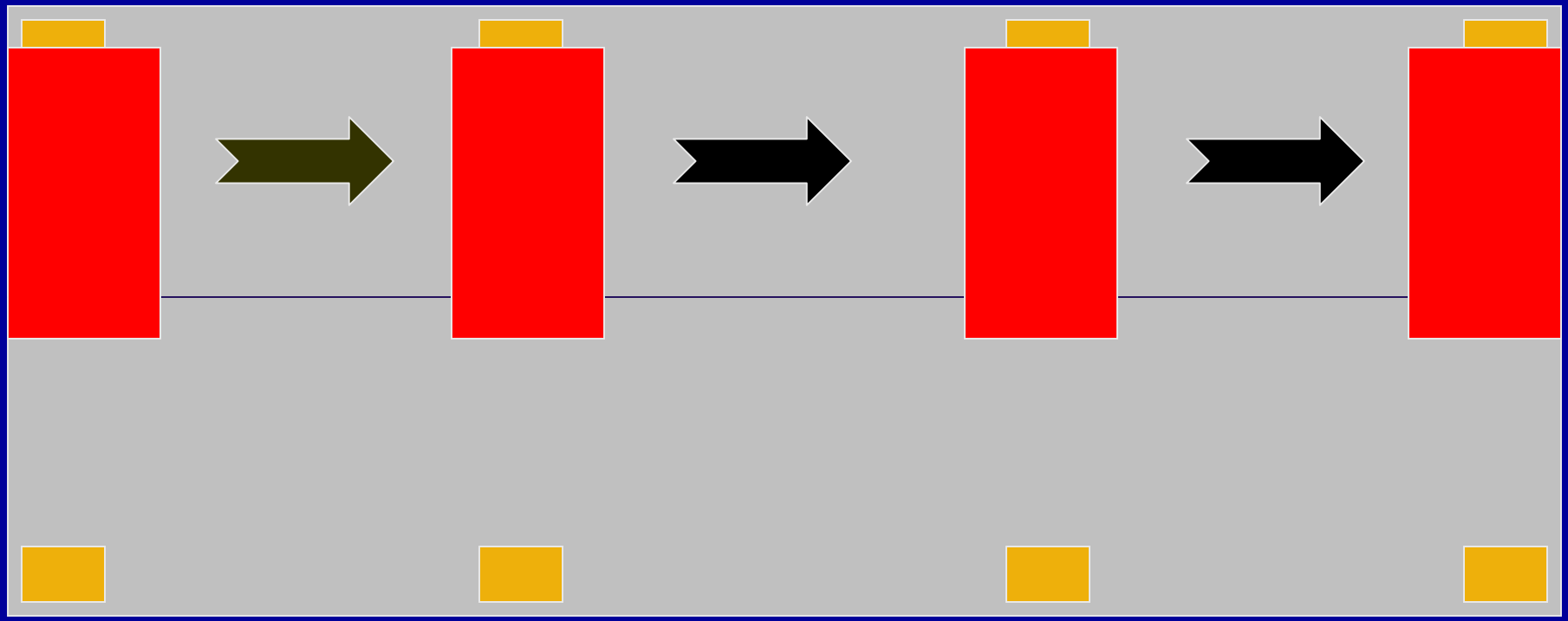
Directional Test Loading Pattern - (4) Section Scale



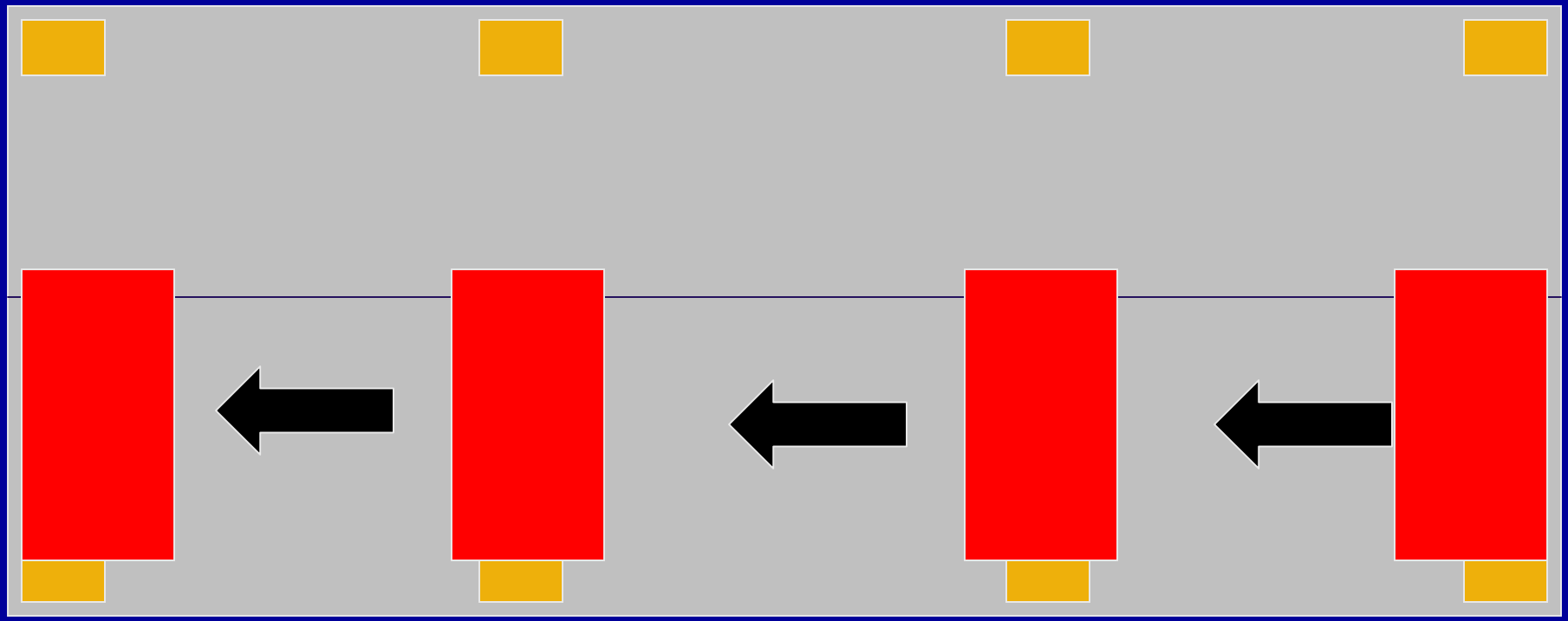
Shift Test Notes

- Vehicle scales should also be tested off-center to verify the accuracy of individual load positions.
- When loading the scale be careful to conform to test patterns and maximum loading requirements.
- After completion of the shift tests, verify zero-load balance before starting any other test.

Off-Center Shift Test



Off-Center Shift Test

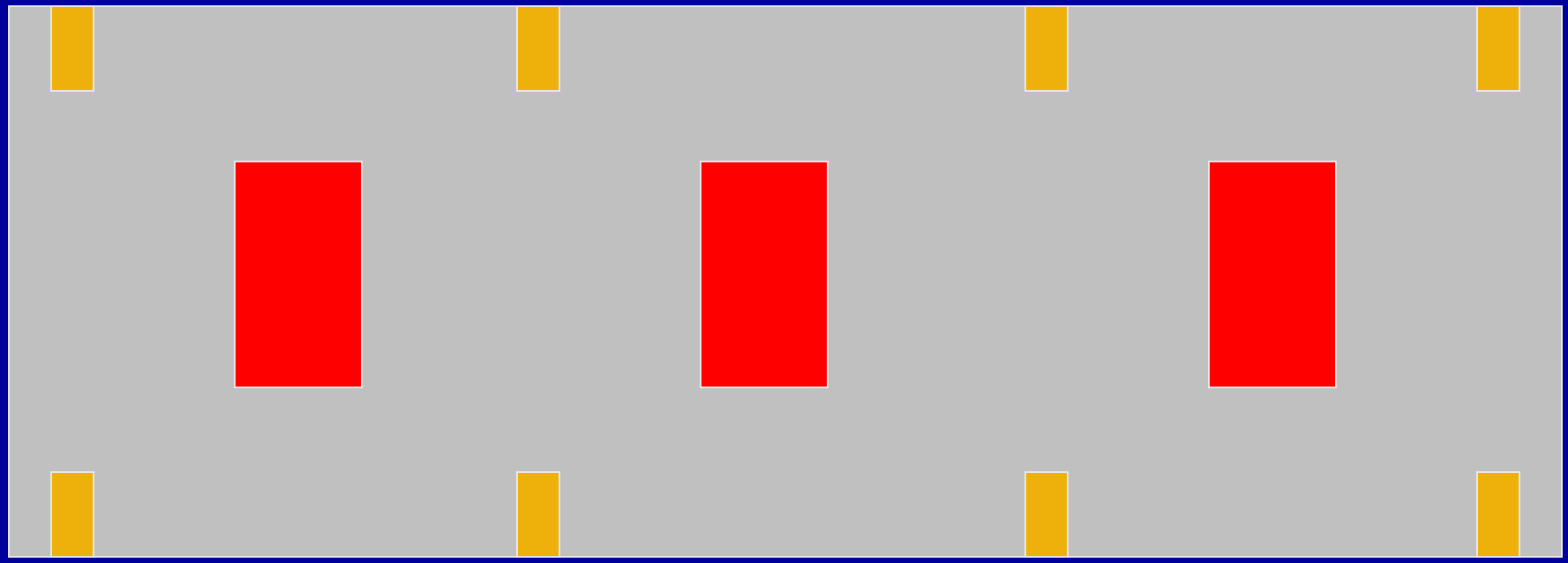


Shift Test Notes

- Midspan and directional tests are typically conducted at the higher of the two shift test loads.
- Midspans are located equidistance between any two adjacent sections.
- Loading at midspans may uncover deflection or other problems in the load receiving element.

Midspan Test Patterns

Four (4) Section Scale



N.1.3.4. Shift Test

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N.1.3.4. Shift Test

N.1.3.4. Shift Test

N.1.2. Decreasing Load Test

- For automatic indicating scales only. The accuracy of the scale is tested as the load is reduced.
- Purpose of test – identify hysteresis, friction and other problems.
- Conducted at one-half maximum test load (but may be verified at any time test weights are removed.)

Other Tests

- Test other indicator functions and features (e.g., for RFI, remote displays).
- S.1.7. Capacity Indication for digital indicators: 105% or *9 d for computing scales (NR 1993).*

N.1.9. Zero Load Balance Change

- A zero-load balance change test shall be conducted on all scales after the removal of any test load. The zero-load balance should not change by more than the minimum tolerance applicable. (Also see G-UR.4.2.)

- Table 6 – 0 to 500 d
  - Acceptance ½ d
  - Maintenance 1 d

N.3. Table 4. Substitution & Strain Load Tests

- How are they conducted?
- How are tolerances applied?
- Why does Table 4, footnote 2 limit the number of substitution tests to only 3?

2003 NCWM

- Added definitions and notes for shift and substitution tests to H44:

- N.1.X. Substitution Test. - In the substitution test process, material or objects are substituted for known test weights, or a combination of known test weights and previously quantified material or objects, using the scale under test as a comparator. Additional test weights or other known test loads may be added to the known test load to evaluate higher weight ranges on the scale.

- Tolerances determined using the total load of test weights and substituted objects or material.

2003 NCWM

- Added definitions and notes for shift and strain-load tests to H44:

- N.1.X. Strain-Load Test. - In the strain load test procedure, an unknown quantity of material or objects are used to establish a reference load or tare to which test weights or substitution test loads are added.

- Tolerances in the strain-load test only apply to the test weights.

N.3. Strain Load Test

N.3. Strain Load Test

N.3. Strain Load Test

Evaluation of Test Results

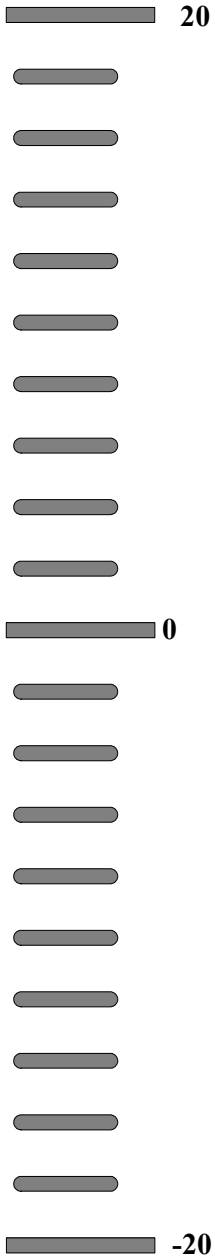
- Tolerance results at all test loads
- Agreement of section test results
- Repeatability
- Return to zero
- Sensitivity at zero and maximum test load
- Compliance with other requirements such as overcapacity blanking and motion detection for printing.

Tests for Electronic Instruments

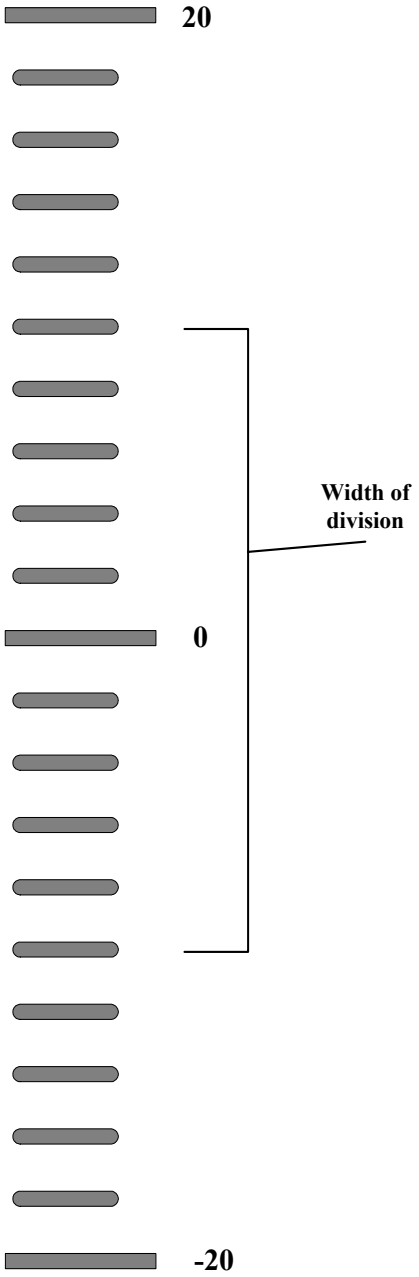
Discrimination
Automatic Zero Tracking
Semi-automatic Zero Tracking
Zero Functions
Motion Detection

Digital Indications

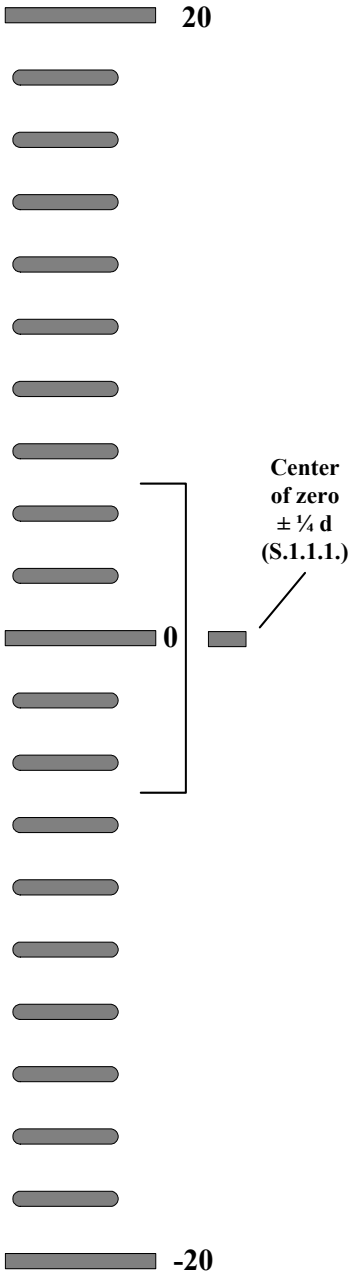
(20 lb divisions)



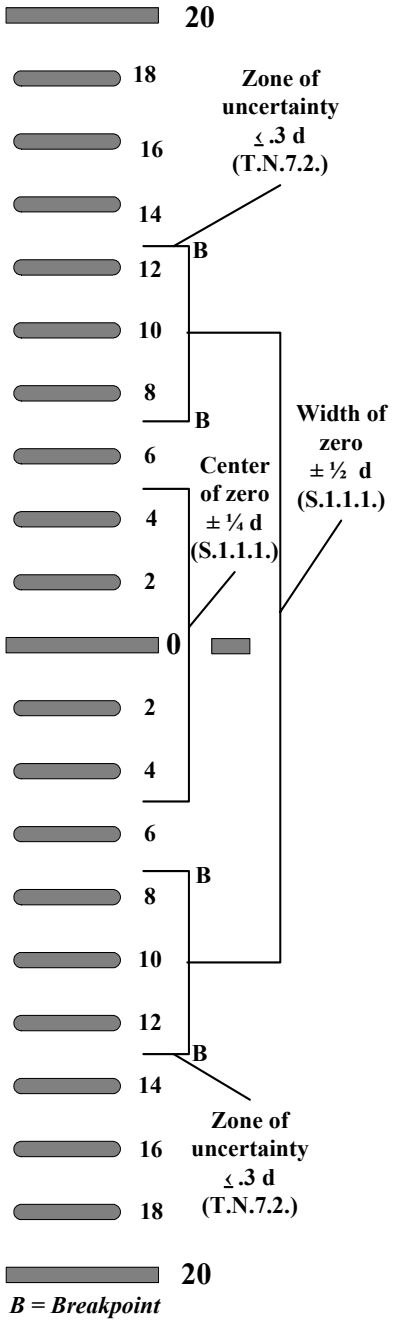
Subdividing Divisions into 10 Equal Parts.



Increment or Width of One Division

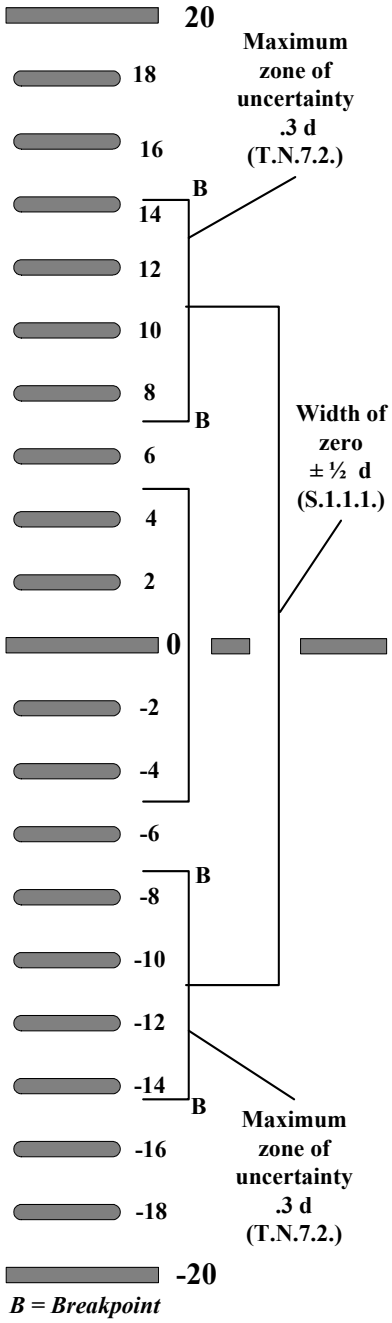


Center of Zero Requirement

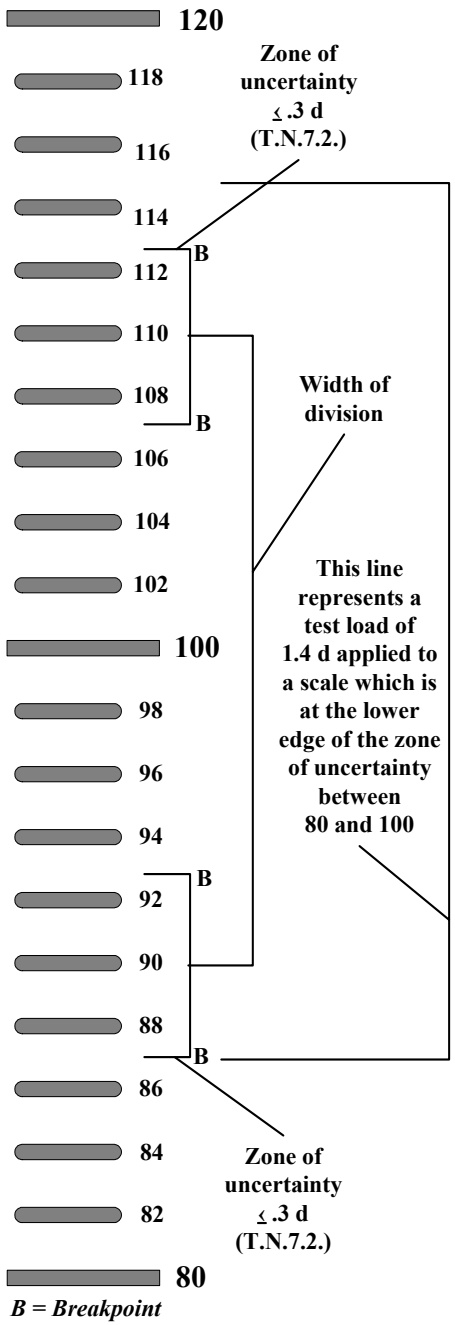


B = Breakpoint

Zone of Uncertainty T.N.7.2.



Why Test Discrimination?



Test For Discrimination at Zero Load

a. With the device on zero, place 20 lb (ten – two pound weights) on the platform.

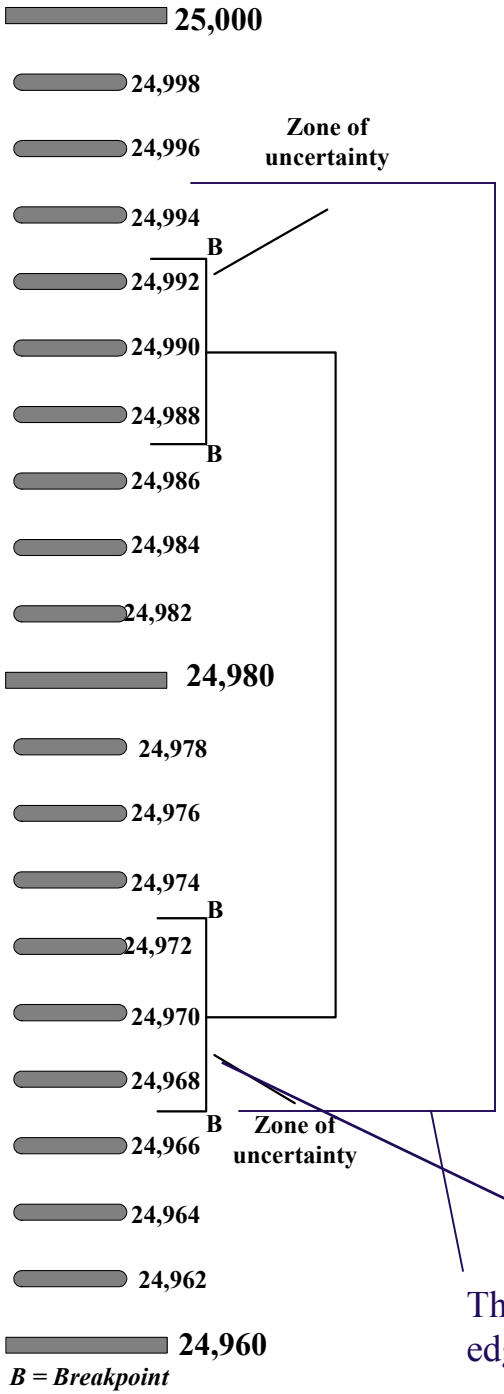
b. Zero the scale and place a load equal to 5 d (100 lb)on the platform.

c. Remove the smaller weights in 0.1 d (2 lb)increments until the indication flickers between 80 lb and 100 lb. The test is conducted just below the lower edge of the zone of uncertainty for increasing load test. (See N.1.5.1.) With the indication flickering, continue removing weights in 0.1 d increments until 80 lb becomes a steady display.

d. Add the test load equal to 1.4 d (28 lb) to the scale.

e. The indication should read a steady 120 lb.

f. If the scale passes this test at a load near zero, the test should be performed near maximum test load.



Discrimination Test at Max Load

a. With the maximum load applied to the scale, (25,000 lb in the example) remove small weights in 0.1 d (2 lb)increments until you just reach the zone of uncertainty. Scale should flicker between 24,980 lb and 25,000 lb.

b. Add 0.1d (2 lb) to cause the reading to become stable just above the edge of the zone of uncertainty (see N.1.5.1.). Indication should read a steady 25,000 lb and be at the high edge of the zone of uncertainty between 24,980 lb and 25,000 lb

c. Remove the test load equal to 1.4 d (28 lb) from the scale.

d. The indication must change by at least 2 d (40 lb) or indicate 24,960 lb.

This line represents a test load of 1.4 d removed from a scale which at the upper edge of the zone of uncertainty between 24,980 lb and 25,000 lb.

Automatic Zero Mechanism (AZM) S.2.1.3.*

How would you test AZM on scales having the following division sizes:

10 lb

20 lb

.01 ton

*Nonretroactive 1/1/81

Testing the Semi-Automatic Zero Mechanism (Push Button Zero) S.2.1.2. Scales in Direct Sale

One type of semi-automatic zero mechanism requires the use of a tool that is entirely separate from the mechanism. How is this type tested?

Testing the Semi-Automatic Zero Mechanism (Push Button Zero)

The second type is simply activated by pressing the zero button on the scale display. How is this type tested?

S.2.5.1. Digital Indicating Element

- "Motion Detection" - recording elements can only print weight values when the indication is stable with 3 d and the values must be within applicable tolerance.

- How is this feature tested?

Special Features - How Are They Used?

- Tare – keyboard, push button, stored, thumbwheel, tare auto-clear
- Gross, tare, net display
- AZM and semi-AZM
- Computers, ticket printers
- Auxiliary displays, scoreboards.

Test Carts and Test Load Patterns

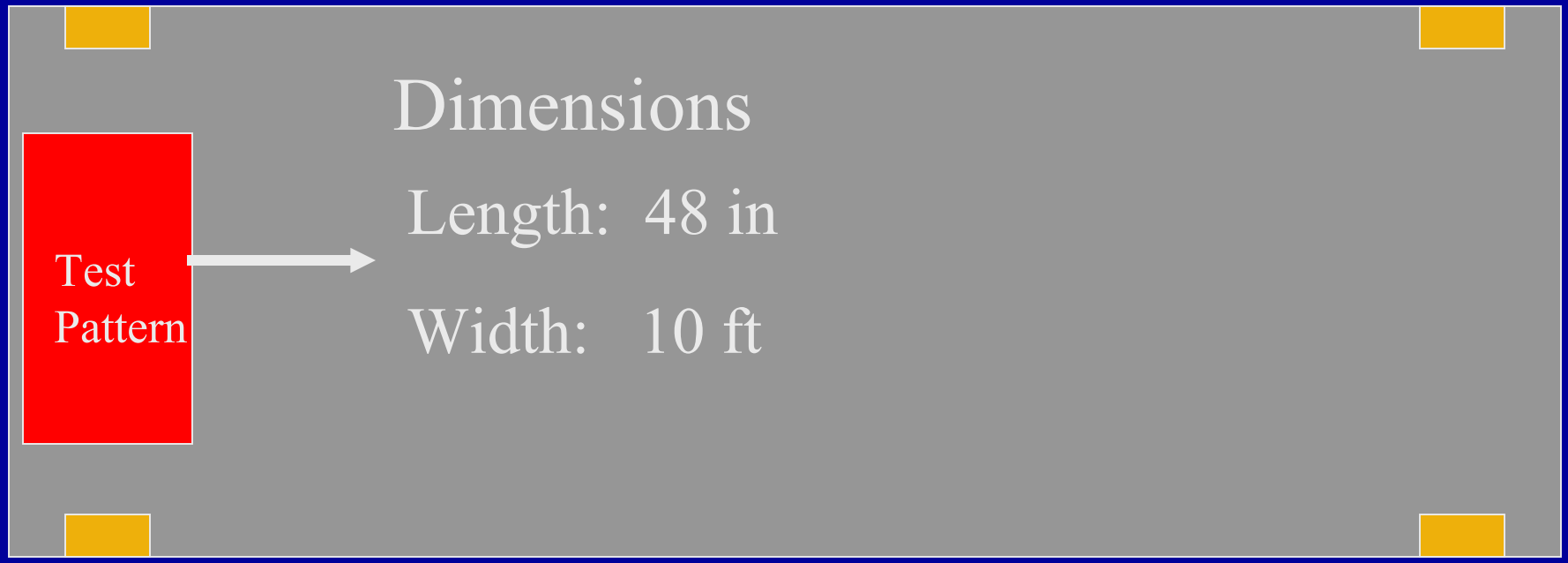
Loading Precautions and the 2003 Amendments to NIST Handbook 44

N.1.3.4.1(b)

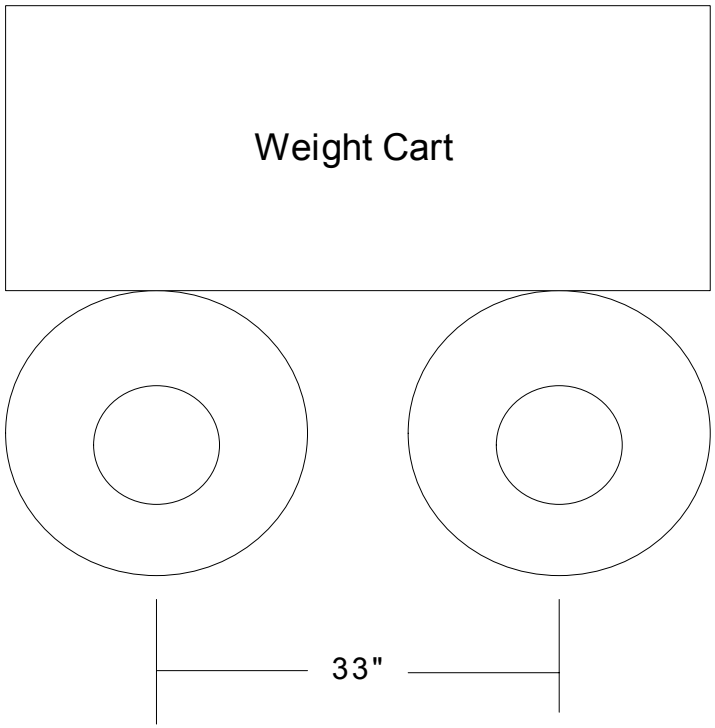
- Prescribed Test Pattern and Loading for Vehicle Scales, Axle-Load Scales and Combination Vehicle/Livestock Scales.
  - Test Pattern is 4 ft in length and 10 ft in width or the width of the platform whichever is less.
  - Multiple test patterns can be used when loaded in accordance with Paragraphs (c), (d),or (e).

Prescribed Test Pattern for a 12 x 30 ft Scale

The prescribed test pattern is 4 ft in length and 10 ft or the width of the load receiving element whichever is less.



Concerns Over High Density Loading



Wheelbase of Cart

Loading Precautions

One side of the test pattern shall not be loaded to more than one-half the CLC or test load before loading the other side.

Never exceed the CLC of the scale when loading any test pattern.

Cart Loading Precautions

- If the test pattern (cart wheelbase) is less than 4 ft, use the formula (length of test load divided by 48 in) x 0.9 x CLC to determine the maximum load you can apply.

- When the test pattern (cart wheelbase) exceeds 4 ft in length, the maximum load shall not exceed the CLC times the largest “r” factor in table UR.3.2.1. for the length of the area covered by the load.

Testing Special Designs

To test to nominal capacity, multiple patterns may be simultaneously loaded in a manner consistent with the method of use.

Special design scales and those wider than 12 ft. shall be tested in a manner consistent with the method of use but following the prescribed principles.

Defining the Test Pattern

- Scale Description:
  - 100,000 x 20 lb
  - 12 x 60 ft Platform
  - 4 Sections/40,000 lb CLC
- Test Cart Dimensions: Wheelbase 33 inches - 50 inches wide.

➢ **Question: what are the dimensions of our test pattern for conducting the shift test?**

Answer:

- ✓ The test pattern will be 33 inches (in length on the platform) x 10 ft (in width of the platform)

Reason: the length of the test pattern changes based on the length (or wheelbase) of the test load. The width of the test pattern is a constant – either 10 ft or the width of the platform whichever is less.

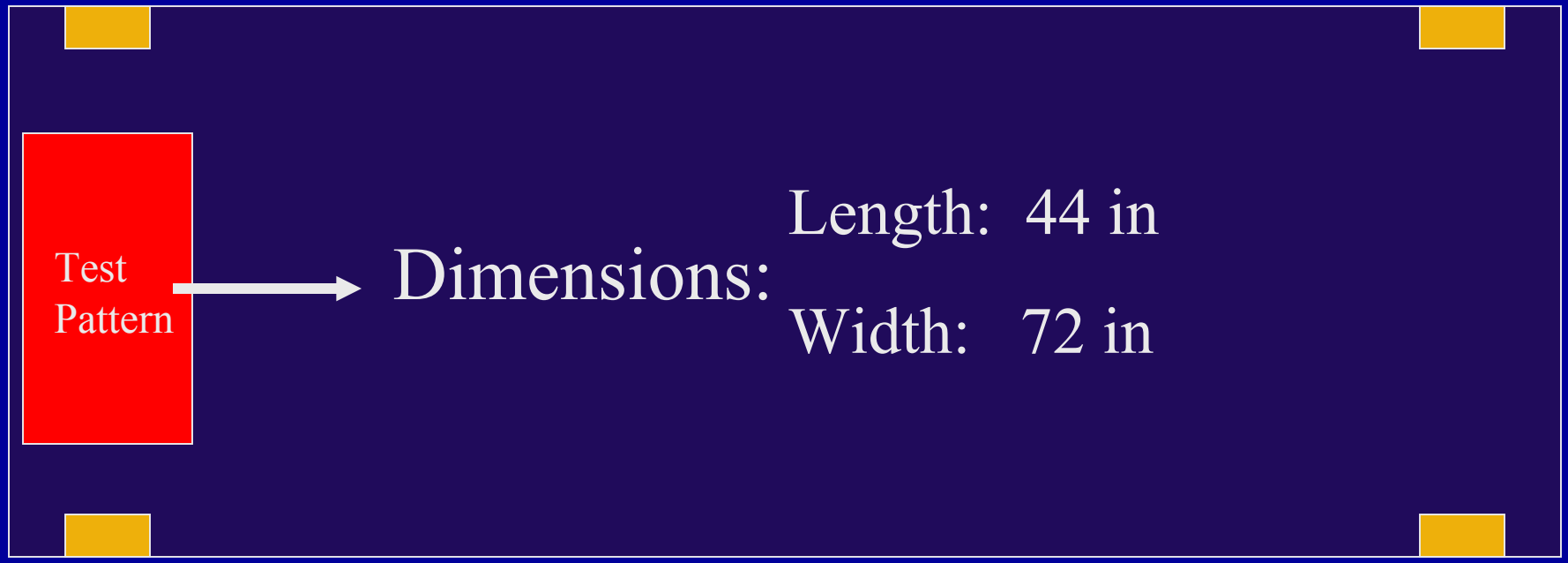
Maximum Load Calculations

- Scale Description:
  - **100,000 x 20 lb Scale**
  - **12 x 60 ft Platform**
  - **4 Sections 40,000 lb CLC**
  - **Dimension of Test Cart: 33 inch wheelbase and 50 inch width.**

- **Question:** Using this test cart, what is the maximum test load that we can safely apply to the test pattern?

Determining the Maximum Loading

Formula: [(wheel base of test cart (33 in.) or length of test load divided by 48 in) x 0.9 x CLC]



Answer:

- ✓ **Total load of Test cart with weights cannot exceed 24,750 lb for this test pattern.**

- Reason: The formula for calculating the maximum test load for a test pattern that is less than 4 ft in length of the platform is (*length of test load divided by 48) x 0.9 x CLC.*
- The calculation: (33/48) x 0.9 x 40,000 lb = .6875 x 0.9 x 40,000 = 24,750 lb

Defining the Test Pattern

- Scale Description:
  - 100,000 x 20 lb Scale
  - 10 x 60 ft. Platform
  - 4 Sections 40,000 lb CLC
  - Test Cart Dimensions: 58 in. wheelbase and 67 in. width. (2 axle)

- **Question: What are the dimensions of our test pattern for conducting the shift test?**

Answer

- ✓Our test pattern will be 58 inches in length of the platform x the width of the platform (10 ft.).

Reason: It is the length of the test pattern that changes based upon the length of the test load. The width of the test pattern is a constant – either 10 ft or the width of the platform whichever is less.

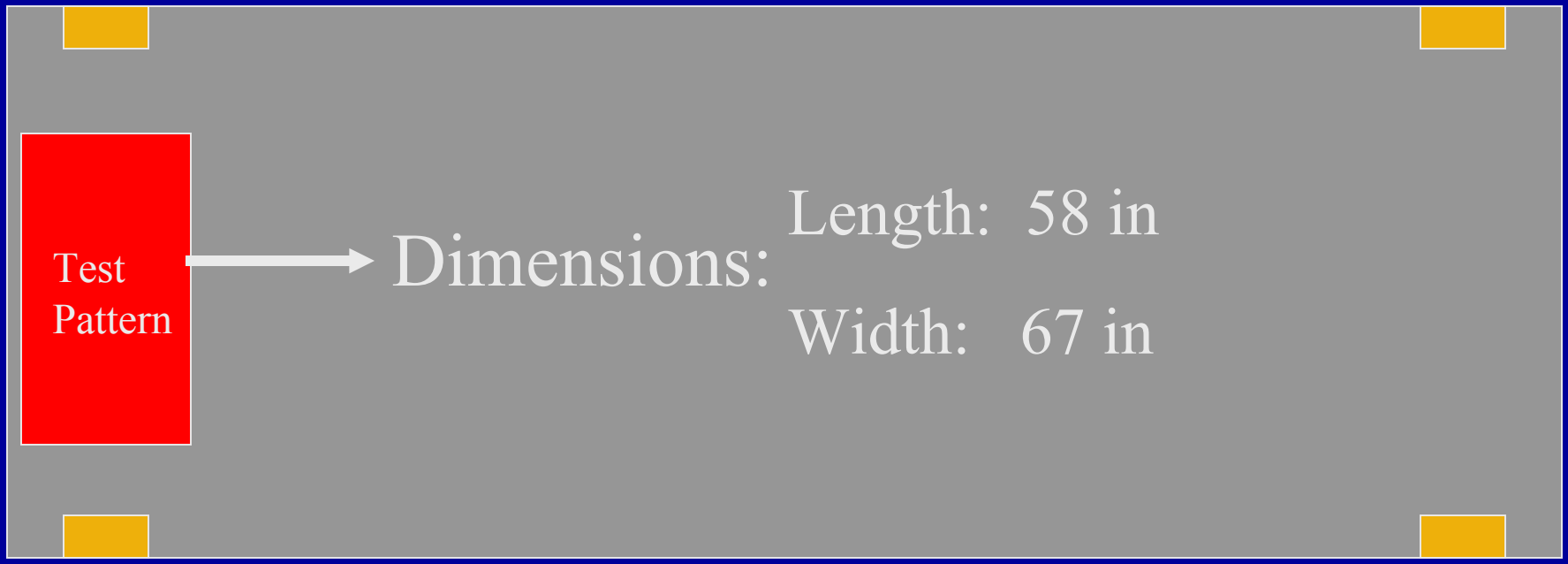
Maximum Load Calculations

- Scale Description:
  - 100,000 x 20 lb Scale
  - 10 x 60 ft. Platform
  - 4 Sections, 40,000 lb CLC
  - Test Cart Dimensions: 58 inch wheelbase and 67 inches width. (2 axles)

- **Question:** using this test cart, what is the maximum test load that we can safely apply to this test pattern?

Determining Maximum Loading

Hint: When the length of the test pattern exceeds 48 in., the max load shall not exceed the CLC x the largest "r" factor in Table UR 3.2.1. For the length covered by the test load.



Answer 4.

40,000 lb x 1 = 40,000 lb.

Reason: The formula for calculating the maximum test load for a test pattern that exceeds 4 ft in length of the platform is the CLC times the largest "r" factor in Table UR.3.2.1. for the length of the area covered by the test load.

Note: The cart wheelbase would have to exceed 8 ft. before CLC is multiplied by a factor greater than one.

NOTICE

Remember that UR.3.2.1 applies not only to the test of the scale but also its **USE**.

Inspect for owner/operator overloading as part of the inspection of the device.

Additional Test Notes for Indicators

Dials, Weighbeams, and Digital Indicators

Testing a Non-automatic Indicating Scale

- Error Weight Testing v. Tolerance Testing.
- Using error weights to test.

Error Weight Testing

- Typically used on beam scales but can used on any automatic indicating scale.
- Small weights are used to determine the exact error in the scale at any test load.
- The exact errors are compared to applicable tolerances to determine performance compliance.

Tolerance Testing

- Pass/fail tolerance test of the device.
- Does not define the exact amount of error in the scale.
- Takes less time.
- Less affected by environmental factors (wind).

Testing the Sensitivity of a Weighbeam

Marked - T.N.6.1.(a)

- Without a balance indicator – T.N.6.2.(a).
- With a balance indicator - T.N.6.2.(b).

Unmarked

- Without a balance indicator – T.2.7.2. and T.3.(a).
- With a balance indicator – T.2.7.1. and T.3.(c).

Testing a Weighbeam

- Sensitivity at zero-load and maximum load.
- Conduct all basic tests
- Full capacity weighbeam – test as many points as possible.
- Fractional weighbeams – two or more points.

Testing a Weighbeam

- If equipped with a T/R beam, print ticket at several test loads.
- Remove all weights and loads and check zero-load balance.

Testing Dial Indicators

- Conduct all of the basic performance tests.
- Test at not less than 3 points on the reading-face, including all possible quarters of the reading-face capacity.
- Verify the accuracy of as many unit weights as possible.

Testing a Dial Indicator

- If equipped with tare bars test at not less than two points on each bar (typically one-half and full capacity).
- If equipped with a ticket printer, print ticket at zero-load, behind zero indication, and at each test load.
- Verify return to zero whenever test loads are removed.

Testing an Electronic Indicating Scale

- Conduct all of the basic performance tests.
- Conduct a discrimination test at zero-load and maximum test load (optional).
- If equipped with a ticket printer, print a ticket at zero-load, behind zero indication, and at every test load.
- Verify return to zero each time test loads are removed.

Testing an Electronic Indicating Scale

- Verify that any tare feature operates only in a backward direction with respect to zero and that all displayed weight values are properly identified.
- If equipped with both a tare feature and ticket printer, make certain printed indications are accurate and properly identified.

N.1.6. RFI/EMI

- If during the test of the scale you may observe erratic readings which may be caused by either RFI/EMI from nearby radios or machinery.

- When RFI/EMI is present, conduct a test for interference under “usual and customary” conditions of use.

Recording of Errors on the Report Form

- Non-automatic versus automatic.
- Under registration vs. Over registration.
- Is the scale under registering (reading light) or over registering (reading heavy).
- How do you tell on a beam scale?

Non-automatic Indicating Method of Recording Errors

Load Position	Test Weights*	Scale Indication	Error
Section 1	4985lbs	5000 lbs	+ 15 lbs
Section 1	9970lbs	10,000 lbs	+ 30 lbs
Section 2	9985lbs	10,000 lbs	+ 15 lbs
Section 3	9990lbs	10,000 lbs	+ 10 lbs
Section 4	10,005lbs	10,000 lbs	-5 lbs
Balance	0		OK

* Indicates amount after removing or adding error weights.

Automatic Indicating Method of Recording Errors

Load Position	Test Weights	Scale Indication	Error
Section 1	5000lbs	5010 lbs	+ 10 lbs
Section 1	10,000lbs	10,030 lbs	+ 30 lbs
Section 2	10,000lbs	10,020 lbs	+ 20 lbs
Section 3	10,000lbs	10,010 lbs	+ 10 lbs
Section 4	10,000lbs	9990 lbs	-10 lbs
Balance	0	0	OK